Economic Quarterly—Volume 94, Number 2—Spring 2008—Pages 147–171

What is the Monetary Standard, Or, How Did the Volcker-Greenspan FOMCs Tame Inflation?

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What is the monetary standard? Another way to ask this question is to ask how central banks control the price level. In this article, I contrast two views. What I term the "quantity-theory" view implies that to control inflation (with the interest rate as its policy instrument) the central bank needs a policy (reaction function) that relinquishes control of real variables to the price system and that controls trend inflation through the way it shapes the expectational environment in which price setters operate. With credibility, a central bank can allow drift in the price level arising from inflation shocks because these shocks do not propagate. What I term the "nonmonetary" view implies that to control inflation the central bank needs a reaction function whose central element is the manipulation of the difference between the unemployment rate and a full employment benchmark for unemployment subject to the constraint imposed by the Phillips curve. The Phillips curve gives the cost in terms of excess unemployment of preventing inflation shocks from propagating into inflation.

Section 1 exposits the quantity-theory view while Section 2 makes it relevant to actual central bank procedures. Section 3 presents the nonmonetary view. Section 4 treats the contrast between the pre- and post-Volcker periods as an "experiment" in policy procedures useful for choosing between these two views.

The ideas expressed in this article are those of the author and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System. The author gratefully acknowledges helpful criticism from Christopher Herrington, Andreas Hornstein, Thomas Humphrey, Thomas Lubik, Bennett McCallum, and Alexander Wolman. Author e-mail: robert.hetzel@rich.frb.org.

1. THE QUANTITY-THEORY VIEW OF INFLATION

The nominal-real distinction is at the heart of the quantity theory. It arises from the "rationality postulate." Namely, only real variables (physical quantities and relative prices) as opposed to nominal variables (dollar magnitudes) affect individuals' well-being. Because individuals care only about real variables, the implication follows that central banks must care about (control) a nominal variable to control the price level. Central banks possess a monopoly on the creation of the monetary base (a nominal variable). However, because they use the interest rate as their policy variable, money (the monetary base) is determined by market forces. What nominal variable do they control that allows them to influence the behavior of price setters, who care about only real variables (relative prices)? The following explanation proceeds from the insights incorporated in the Cambridge equation of exchange, to the Wicksellian discussion of money supply determination, to the rational expectations discussion of nominal determinacy with central bank interest rate targeting, and finally to discussion of how central banks influence the behavior of price setters.

Equation (1) shows the Cambridge equation of exchange:

$$m_t \cdot \frac{1}{p_t} = k(r_t) \cdot y_t, \tag{1}$$

with m_t the nominal money stock; p_t the price level; $k(r_t)$ the fraction of its income the public desires to hold in the form of money, which depends on the nominal interest rate, r_t; and y_t real income (Pigou 1917). Equation (1) receives content from the assumption that the central bank can cause nominal money, m_t, to change independently of the public's demand for real money (purchasing power), $k(r_t) \cdot y_t$. In these circumstances, the price level will adjust. As a heuristic illustration of how nominal money can change without a prior change in real money demand, Milton Friedman ([1969]1969) made famous the example of a drop of helicopter money.[1]

This formulation is not generally applicable to historical experience because central banks have only rarely attempted to control money directly through targets for monetary aggregates.[2] Nevertheless, what is captured by the quantity-theory appellation is that changes in the price level function as an equilibrating variable in a way that depends on how the central bank controls money creation. In the case in which it pegs its exchange rate to another currency, the price level varies to cause the real terms of trade to vary to equilibrate the balance of international trade. In the case of floating exchange rates, as highlighted in equation (1), the price level (or the goods

[1] On Friedman's contributions to monetary economics, see Hetzel (2007).

[2] For references to central bank attempts to use money targets, see Rich (1987), Neumann (1997), and Hetzel (2008, chap. 13).

price of money—the inverse of the price level) varies to endow the nominal money stock with the purchasing power desired by the public. In this sense, the price level varies to clear the market for the quantity of money. It is this power to control money creation that provides the central bank with control over the domestic price level. But how does it exercise this power? The answer is not obvious because nominal money is demand-determined (determined by the public) given the use of an interest rate by central banks as their policy instrument.

An answer to this question starts with an understanding of a long tradition associated with the name of Knut Wicksell.[3] It is useful to recapitulate this literature from its earliest quantity theory roots in the mid-18th century through its most recent rational expectations formulation in the mid-1980s. The British economist David Hume introduced the central analytical distinction of the quantity theory—the nominal/real dichotomy. Both he and Adam Smith explained how the increase in money caused by the New World gold discoveries would leave the interest rate on capital unaffected.[4] Among others, the later British economists Henry Thornton, David Ricardo, James Mill, Alfred Marshall, and Arthur Pigou emphasized that the productivity of capital determines the real rate of interest relevant to investors (the "natural" rate).

Writing during the suspension of the gold standard at the time of the Napoleonic Wars, Henry Thornton became the first one to understand a central bank as a creator of fiat (paper) money. Thornton was also the first one to explain changes in the supply of money as a manifestation of the difference between the bank rate and the natural rate (the real rate of interest determined by the productivity of capital) (see Hetzel 1987, 9). If the central bank maintains a rate of interest different from this natural rate of interest, the nominal stock of money would change independently of prior changes in real money demand and the price level would have to adjust. In the 1820s, Thomas Joplin associated bank deposit creation with the excess of demand for investment over saving caused by a rate charged on bank loans below the natural rate earned on capital.

Wicksell offered the most famous statement of how changes in the money stock arise when the interest rate set by banks or the central bank differs

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[3] The discussion draws on Humphrey (1974, 1983b, and 1990). See also Humphrey and Keleher (1982).

[4] Hume ([1752]1956) wrote in *Political Discourses* (cited in Humphrey 1983b, 13): "Money having chiefly a fictitious value, the greater or less plenty of it is of no consequence. . . .[I]f you lent me so much labour and so many commodities; by receiving five per cent, you always receive proportional labour and commodities."

from the natural interest rate.[5] Wicksell ([1898]1965, 120, 148, and 189) also prescribed a price level rule for setting the interest rate peg:

> [T]here is a certain level of the average rate of interest which is such that the general level of prices has no tendency to move either upwards or downwards. . . .Its magnitude is determined by the current level of the natural capital rate and rises and falls with it. If. . . the average rate of interest is set and maintained *below* this normal level. . . prices will rise and go on rising.
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> [O]nce the entrepreneurs begin to rely upon this process continuing—as soon, that is to say, as they start reckoning on a future rise in prices—the actual rise will become more and more rapid. In the extreme case in which the expected rise in prices is each time fully discounted, the annual rise in prices will be indefinitely great.
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> If prices rise, the rate of interest is to be raised; and if prices fall, the rate of interest is to be lowered.

What prevents the "entrepreneurs" cited by Wicksell from looking ahead to the "indefinitely great" rise in prices and initiating an immediate rise in prices that prevents any leverage of the central bank over the bank-rate/natural-rate discrepancy? This issue appears in Friedman's ([1968]1969) restatement of the implication that an arbitrary interest rate peg by the central bank would produce an indefinite rise in the price level. By incorporating Irving Fisher's (1896) distinction between nominal and real interest rates, Friedman pointed out that increases in expected inflation would lower the real interest rate corresponding to the nominal rate peg and would thereby intensify money creation and the rise in inflation. Sargent and Wallace (1975, 250) derived an expression that makes the contemporaneous price level a function of the expected future price level and used it to reformulate the Friedman/Wicksell critique of how an arbitrary interest rate peg leaves the price level unanchored. "The public therefore expects that, ceteris paribus, any increase in p_t [the price level] will be met by an equal increase in m_t [the nominal money stock]. . . .There is then nothing to anchor the expected price level." However, McCallum (1981, 1986) pointed out that a central bank that uses the interest rate as its policy instrument can follow a rule that ties down the public's expectation of a nominal variable (either money or the future price level), thereby rendering the price level determinate.[6]

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[5] Wicksell's analysis did not incorporate the distinction between the nominal and real interest rate developed by Fisher (1896). Friedman ([1968]1969) first combined this distinction with the Wicksell analysis. For a discussion of the history of the distinction between real and nominal interest rates, see Humphrey (1983a).

[6] Goodfriend (1987) extended the analysis by showing that the central bank's rule need only constrain how the public forms its expectation of the price level in response to shocks. Through its loss function, the central bank must care about jumps in the actual price level (relative to the

The McCallum result permits an understanding of actual central bank procedures for controlling inflation by reconciling the endogeneity of money with price level determinacy. His result rests on the rational expectations hypothesis that the central bank can condition the inflationary expectations of price setters (firms) through consistent behavior. But how, given the rationality postulate that requires that the central bank control something real if it is to influence the behavior of private agents whose welfare depends only on real variables? Because central bank use of an interest rate instrument renders money endogenous, its control over prices does not work off a quantitative target for money and a real-balance effect.[7] It follows that the control of prices must derive from the central bank's ability to control the public's expectation of the value of money. Specifically, the central bank must influence the behavior of firms through its control over this expectation. Its control over inflation must work off the desire of firms to set a relative price (a real variable) when they set the dollar price of their product.

One can think of the changes in dollar prices that firms make as comprising two components. The "relative-price-altering" component originates in a desire to change the relative price of their product. The "relative-price-preserving" component originates in a desire to prevent changes in the price level from altering the relative price that firms desire for their product. This component makes dollar price setting depend on forecasts of the future behavior of the price level.[8] Because of these changes in the price level, firms face a coordination problem. Namely, how do they change their dollar price in tandem with the change in the average dollar prices of other firms? The rational expectations hypothesis is that, with respect to the relative-price-preserving component of changes in dollar prices, firms will coordinate on the systematic part of monetary policy. But why should they look to the central bank rather than to some extraneous variable ("sunspots") in solving this coordination problem? As explained below, the central bank has the ability to "shock" real

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expected price level) and must care about expected changes in the future price level. A central bank concerned about the "inflationary psychology" of bond markets will naturally possess such concerns. The introduction of a third concern beyond the smoothing of actual and expected changes in the price level, namely, a desire to smooth the interest rate, introduces drift in the price level (relative to trend).

One can understand the Goodfriend/McCallum analysis as an application in the monetary area of the general argument for rules made in Lucas ([1980]1981, 255): "[O]ur ability as economists to predict the responses of agents rests, in situations where expectations about the future matter, on our understanding of the stochastic environment agents believe themselves to be operating in. In practice, this limits the class of policies the consequences of which we can hope to assess in advance to policies generated by fixed, well understood, relatively permanent rules (or functions relating policy actions taken to the state of the economy)."

[7] With nominal money fixed, an increase in the price level reduces real money and real spending through the real-balance effect (Patinkin 1965).

[8] In a world of expected price stability, firms only change dollar prices to change relative prices. The enhanced ability of the dollar to serve as a numeraire (a measure of relative prices) is the basis for arguments that the central bank should make price stability its objective.

economic activity through unanticipated money creation (destruction) if the public's inflationary expectations differ from its objective for trend inflation.

To understand this ability, consider the case where the price level evolves unpredictably.[9] Assume, for illustrative purposes, that each period the central bank chooses a random, unannounced target for the price level. In particular, assume that without announcement the central bank sets this period's target for the price level below last period's target. Although individual firms will notice a fall in the demand for their product, that information does not reveal the new price level target.[10] Imagine now a Walrasian "nominal" auctioneer who calls out price levels successively lower than last period's target. Individual firms coordinate reductions in their dollar prices using the auctioneer's announced price level to preserve their relative prices. The process ends when firms resume selling an amount consistent with their profit-maximizing markup.[11] If the central bank behaves in a way that renders the evolution of the price level predictable, the resulting common expectation of the future price level serves the function of the auctioneer.

The rational expectations logic that price setters form their expectations in a way that conforms to the systematic part of monetary policy is that any predictable sequence of price level targets leaves real variables unaffected (apart from possible changes in real money demand). In contrast, if monetary policy causes the price level to evolve in an unpredictable way, it becomes harder for the individual firm to predict how other firms will change their dollar prices. In the case of unanticipated deflation, the first firm to lower its price sells at a loss by selling too much. The price stickiness that accompanies an unpredictable monetary policy shock results from the cost to firms of changing their dollar prices as part of an uncoordinated tâtonnement process to discover the price level consistent with potential output. Because there is a social externality to lowering an individual dollar price to achieve the required reduction in the price level that the individual firm does not capture, individual firms are slow

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[9] An historical analogue is the real bills period when the Fed tried to restrain what it considered speculation in commodity and stock markets or the stop-go period when it shifted between attempting to target the unemployment rate and inflation (Hetzel 2008, chaps. 3, 23, 24, and 25). For other countries, central bank attempts of uncertain duration to influence the foreign exchange value of their currencies are an example.

[10] The money stock will fall, but variation in the demand for money obscures the implications of nominal money for the price level target.

[11] The auctioneer is omniscient in that he knows that the reduction in aggregate demand is a nominal phenomenon, not a real one due, say, to a perceived reduction in productivity growth that makes the public feel poorer. He also knows when firms' markups (price over marginal cost) return to their profit-maximizing levels. At that time, he ceases to call out reductions in the price level.

The markup is a real variable. Although monetary contraction leads initially to its expansion (assuming no labor hoarding), ultimately firms collectively change their dollar prices to leave the markup at its profit-maximizing (natural) value. See Goodfriend (2004) and Goodfriend and King (1997).

to lower their dollar prices in response to an unanticipated fall in aggregate nominal demand.[12]

One can now answer the question of how the central bank controls the behavior of firms to achieve a desired trend rate of inflation. The self-interest of firms in getting their relative prices right causes them collectively to coordinate on the predictable behavior of the price level in setting price-preserving dollar prices. Of course, that common coordination presupposes the credibility of monetary policy. If the expectation of inflation in the marketplace diverges from the central bank's inflation target, the central bank must create (destroy) money in a way that shocks the real economy.[13] There is a "stick in the closet," but with credibility, the central bank need never take it out.

2. MONETARY CONTROL WITH AN INTEREST RATE INSTRUMENT

The quantity-theory framework reviewed above guides the search for empirical generalizations summarizing central bank behavior that are capable of explaining when the central bank is successful in controlling inflation.[14] This framework implies the necessity for disciplining the central bank reaction function in two ways. First, the central bank must possess procedures that allow it to set the short-term interest rate in a way that tracks the natural rate of interest (i.e., allows the price system to work). The incessant analysis of the real economy engaged in by central banks implies procedures more complicated than the rule advocated by Wicksell of responding directly to the price

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[12] As a result, the ability of money to serve as a numeraire diminishes. The coordination necessary to allocate resources among specialized markets requires that the price system convey information about the relative scarcity of resources. The requisite economy of communication depends on the use of money as a numeraire. That is, changes in dollar prices should convey information about changes in the relative scarcity of resources. Unpredictable evolution of the price level lessens the ability of money to serve this function. The price system lacks a mechanism for distinguishing between changes in dollar prices required by changes in the scarcity of money and changes in dollar prices required by changes in the relative scarcity of goods. Because there is no way of coordinating the former changes when the price level evolves unpredictably, the dollar prices set by individual firms no longer provide reliable information about the desirability of expanding or contracting output. There is a conflict between the role of the price level as a numeraire and its role as an equilibrating variable that endows nominal money with the purchasing power desired by the public.

[13] The Lucas (1972) Phillips curve, in which the output gap depends on the difference between actual and expected inflation, captures this idea. However, instead of actual inflation the appropriate measure is inflation consistent with the behavior of the central bank. In response to an unanticipated monetary shock that initially impacts output but not inflation, actual and expected inflation may remain identical although expected inflation differs from policy-consistent inflation.

[14] I attribute the success of monetary policy in the Volcker-Greenspan era to its underlying consistency and to the way that consistency shaped inflationary expectations. However, the relentless exercise by the FOMC of reading how the real economy responds to shocks obscures the rule-like behavior of the central bank imposed by the discipline of maintaining low, constant-trend inflation. In contrast to this view, Blinder and Reis (2005) attribute the success of monetary policy in the Greenspan era to the exercise of ongoing discretion. For a more complete discussion, see Hetzel (2008, chap. 21).

level. Second, there must be something systematic in central bank procedures that ties down the way that the public forms its expectation of the future price level (i.e., provides a nominal anchor).

I characterize the underlying consistency in the procedures that restored near price stability in the Volcker-Greenspan era as lean-against-the-wind (LAW) with credibility (Hetzel 2008, chaps. 13–21). Specifically, the FOMC raised the funds rate in a measured, persistent way in response to sustained increases in the rate of resource utilization (declines in the unemployment rate) subject to the constraint that bond markets believed that such changes would cumulate to whatever extent necessary to maintain trend inflation at a low, unchanged rate. In the event of an inflation scare (a sharp jump in the long-term bond rate), the FOMC raised the funds rate more aggressively (Goodfriend 1993; Hetzel 2008, chaps. 13 and 14). Conversely, the FOMC lowered the funds rate in a measured, persistent way in response to sustained declines in the rate of resource utilization subject to the constraint that bond markets believed that such changes would not cumulate to an extent that would raise trend inflation.

The "persistent" part of the "measured, persistent" changes in the funds rate made in response to sustained changes in the degree of resource utilization captures the search for the (unobserved) natural rate.[15] What is important is that the FOMC does not derive its funds rate target analytically from a real intermediate target like excess unemployment but rather follows a procedure that turns determination of the (real and nominal) funds rate over to the working of the economy. Although the FOMC exercises transitory control over the short-term real rate of interest, it does not control the real interest rate in a sustained way.[16] By extension, neither does it determine other real variables such as the unemployment rate (Hetzel 2005, 2006).

Implementation of these procedures required judgment. Much of the FOMC's wide-ranging review of economic activity involved assessment of whether aggregate-demand shocks (changes in resource utilization rates) were sustained or transitory, with only the former calling for funds rate changes. With respect to the "measured" characterization, on rare occasions, incoming data on the economy changed rapidly from offering mixed signals to offering a strong, consistent signal on the change in resource utilization. On these

[15] The natural rate can be thought of as the real interest rate consistent with complete price flexibility (the absence of monetary nonneutrality). Alternatively, one can think of the natural rate as consistent with the operation of the real business cycle core of the economy (Goodfriend 2007).

[16] This assumption lies in the Wicksellian tradition, referred to in Section 1, which assumes that the natural rate of interest is determined by real factors. For example, Pigou (1927, 251) argued for the determination of the real interest rate by real factors, specifically "by the general conditions of demand and supply of real capital. . . .[T]he Central Bank, despite its apparent autonomy, is in fact merely a medium through which forces wholly external to it work their will. Though. . . in determining the discount rate, the voice is the voice of the bank, the hands are not its hands" (cited in Humphrey 1983b, 19).

occasions, for example at the start of the recessions in year-end 1990 and early 2001, the FOMC moved the funds rate by a larger amount than the typical one-quarter percentage point.[17] What is important is not the period-by-period timing of funds rate changes but rather the overall discipline imposed by the requirement of nominal expectational stability. At times of increasing resource utilization, financial markets must believe that funds rate increases will cumulate to whatever extent necessary to maintain trend inflation unchanged at a low level. At times of decreasing resource utilization, markets must believe that funds rate decreases will be reversed when necessary to maintain trend inflation unchanged.

These LAW-with-credibility procedures condition the behavior of financial markets. In response to real aggregate-demand shocks, markets predict the future path of the funds rate necessary to return output to potential, but they do not have to forecast the impact on output of an expansionary or contractionary monetary policy that would force changes in inflation. The resulting continuous variation in the yield curve in response to incoming information on the economy, in which all the variation in future forward rates is real, reduced fluctuations in real output around trend and produced the period of inflation and output stability known as the Great Moderation.[18] The economic forecasts that determine the shape of the yield curve are subject to error, but the process is continually self-correcting. Persistently signed innovations in incoming economic data cause cumulative movements in the yield curve. Note that policymakers and markets "converse" with each other. Central banks do not make public an expected path for the funds rate, but they freely share information about their own forecasts of the economy. Markets then set the yield curve.

The real world counterpart of the quantity-theory thought experiment of an exogenous change in money occurs when markets misforecast the nature and magnitude of a shock for a significant period of time. Consider underestimation by the markets of the magnitude and persistence of a positive real shock so that initially the yield curve fails to rise to the extent required to return real output to trend. Money increases beyond the amount necessary to keep inflation unchanged and portfolio rebalancing occurs (Goodfriend 2000).[19] That

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[17] Such information implies that the contemporaneous level of the real funds rate differs significantly from its natural value.

[18] For a discussion of the issue of whether the Great Moderation resulted from better monetary policy or fewer macroeconomic shocks, see Velde (2004).

[19] For example, in the last part of the 1980s, the yen appreciated strongly. Under the assumption that this appreciation would dampen export growth and inflation, the Bank of Japan (Finance Ministry) did not raise the discount rate. Given the credibility of monetary policy for price stability, money (M2) growth rose initially without inflation. Portfolio rebalancing appeared in the form of a rise in equity prices and output growth rose strongly (Hetzel 1999). Another example occurred in fall 1998 and spring 1999. At the time, markets widely expected that the Asia crisis would spread and would create worldwide recession and even deflation. In response, the yield

is, money creation causes portfolio holders to rearrange their asset portfolios by buying fewer liquid assets such as bonds and stocks. The prices of these assets rise and their yield falls. In response to the increase in money, the price level rises but without an increase in trend inflation as long as monetary policy remains credible. Especially because of the difficulty of determining the persistence of a shock, it is inevitable that episodes will occur when real shocks push output away from trend and affect the price level. Nevertheless, what is remarkable is how well monetary policy has worked over the last quarter century.

The quantity-theory framework outlined in Section 1 and the above characterization of the FOMC's reaction function in the Volcker-Greenspan era offer a description of the control of inflation in terms of monetary control. Assume that a central bank possesses credibility for a policy of price stability and that its reaction function allows it to set an interest rate peg equal to the natural rate (the rate consistent with perfectly flexible prices). Under this assumption, the central bank merely accommodates changes in the demand for real money associated with whatever real forces drive growth in the real economy plus random changes in real money demand.[20] These are "price-preserving" changes in money.

To illustrate "price-altering" changes in money, consider the example in which the central bank raises its interest rate peg with a lag in response to a permanent real shock to productivity growth that increases the value of the natural rate (Hetzel 2005). The counterpart of the resulting bank rate/natural rate discrepancy is a demand for a flow of services from the capital stock and a flow of consumption that exceeds the amounts given by a hypothetical real economy with completely flexible prices. The price paid for the utilization of resources today is set too low in terms of resources foregone tomorrow. Corresponding to this excess demand for resources is a flow of credit demanded of banks by the public. With a funds rate left unchanged by the central bank, banks accommodate this additional demand through an increase in their deposits. Maintenance by the central bank of the real interest rate below the natural rate is a form of price fixing that creates an excess supply of money (demand for credit) as the counterpart to goods shortages. The concomitant monetary emissions force portfolio rebalancing and changes in the price level

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curve fell. In the event, the U.S. stock market rose strongly in 1999 and domestic consumption surged (Hetzel 2008, chaps. 17 and 18).

A transitory rise in output (consumption) relative to expected future output (consumption) restrains the rise in the real interest rate (Hetzel 2005).

[20] Money holders who desire additional real money balances sell debt instruments such as Treasury bills to banks and receive demand deposits in return. The central bank accommodates any increase in required reserves as a consequence of maintaining its interest rate peg. Changes in nominal money demand match changes in real money demand so that the price level need not change.

(Hetzel 2004). These are "price-altering" changes in money because they occur with no prior increase in real money demand.

A policy procedure that disciplines money creation to allow only for price-preserving changes in money imposes two sorts of disciplines (real and nominal) that correspond to the two characteristics of the LAW-with-credibility characterization of the Volcker-Greenspan procedures. The first (the real) discipline entails the LAW characteristic whereby the real funds rate tracks the natural interest rate. As long as the central bank maintains the real interest rate equal to the natural rate, real money grows in line with the real money demand consistent with the hypothetical operation of the economy with complete price flexibility and with real money demand shocks.[21] The second (the nominal) discipline entails credibility for maintenance of an unchanged trend inflation rate despite recurrent real aggregate-demand shocks and inflation shocks. Credibility means firms coordinate the relative-price-preserving changes in their dollar prices on the central bank's inflation target. Expected inflation then equals the central bank's inflation target. This level of expected inflation drives an equal amount of money growth and inflation.

The final component of money demand that adds to money growth arises from an inflation target as opposed to a price level target. This component accommodates transitory inflation shocks (relative price shocks that pass through to the price level) and thus allows the price level and money to wander but without affecting trend inflation.[22] The central bank can accommodate inflation shocks as long as it is credible. Specifically, the central bank can target core inflation (inflation stripped of volatile series like food and energy) while assuming that expected trend inflation remains unchanged. That is, the public does not extrapolate variability in observed inflation into the future. Subject to credibility, the central bank's reaction function causes nominal money demand to grow at a rate that does not require the inflation rate to differ from its target. All changes in money are price-preserving.

3. THE NONMONETARY VIEW OF INFLATION

The term "quantity theory" focuses on the kind of analytical framework useful for understanding the behavior of the price level by directing attention toward the way in which the central bank controls money creation. Trivially, as made

[21] The behavior of the economy is determined by its real business cycle core.

[22] Depending on the time-series properties of inflation shocks, inflation exhibits both persistence and variability around trend. It is important not to confuse that observed persistence (positive autocorrelation) in inflation with intrinsic (hard-wired) inflation. It does not follow that the central bank is reducing the variability of output by increasing the variability of inflation. At the same time, if the central bank attempted to eliminate transitory fluctuations in inflation around trend, it would increase the variability of output. Credibility allows it to control inflation without adding variability to output beyond what is built into the response of the real business cycle core of the economy to shocks.

evident by the discussion of the equation of exchange (1), real factors affect the price level. In contrast to the quantity-theory view, nonmonetary views make these real factors into the central actors determining the price level. In the form of an inflation shock, they raise the price level. A built-in rigidity in prices allows the central bank to reduce growth in real expenditure by lowering growth in nominal expenditure. As a result, it raises the unemployment rate. The central bank controls inflation by playing off one real factor (an increase in the unemployment rate) against another real factor (an inflation shock). According to this view, the central bank faces a menu of choices whereby it can reduce the variability of inflation by increasing the variability of unemployment, and conversely.

Here, I review the nonmonetary view that is associated with the traditional Keynesian Phillips curve (2). This variant shaped the policymaking environment in the stop-go period, which lasted from 1965 until 1979. The inflation rate is π_t. The output gap, x_t, is the difference between the log of actual output, y_t, and potential output, y_t^p, or $(y_t - y_t^p)$. To give the output gap empirical content, practitioners of this view often use as a proxy the cyclical behavior of output measured by the difference between actual output and a trend line fitted to output. The ε_t is an inflation or cost-push shock.

$$\pi_t = \pi_{t-1} + \alpha x_{t-1} + \varepsilon_t \qquad \alpha > 0 \tag{2}$$

From the perspective of the nonmonetary view, explanations of inflation are eclectic in the sense that each episode of inflation can possess its own primary cause. In the stop-go period, discussions of inflation typically began with a taxonomic classification of the different generic causes of inflation. The major classifications in this taxonomy were aggregate demand (demand-pull) and aggregate supply (cost-push), with propagation of these sources of inflation through intrinsic inflation persistence (a wage-price spiral).[23]

Demand-pull inflation arises from a positive output gap ($x_t > 0$). A variety of influences can boost real aggregate demand. At least through the early 1970s, the consensus among economists was that deficit spending (the full-employment surplus or deficit) exercised a strong influence on real aggregate demand while monetary policy actions, which worked through the interest rate, exercised only a negligible impact. Cost-push inflation arises from positive inflation shocks ($\varepsilon_t > 0$), that is, from factors that affect supply and demand in particular markets. Economists have identified inflation shocks with a large number of factors such as food and energy prices, depreciation of the foreign exchange value of the currency, monopoly power of unions and corporations, and government regulations. As reflected in the value of 1 on the coefficient on the π_{t-1} term, intrinsic inflation persistence propagates

[23] References are legion in the pre-1980 literature. See, for example, Ackley 1961 and Bronfenbrenner and Holzman 1963. See also Hetzel (2008, chaps. 1, 6, 11, 22, and 26).

these shocks unless the central bank offsets them by creating a negative output gap.[24] In the 1970s, economists often attributed inflation to a wage-price spiral set off by the aggregate-demand shock of Vietnam War spending and later the supply shocks of OPEC oil price increases (Nelson 2005 and Hetzel 2008, chaps. 6, 11, and 22).

The nonmonetary view has evolved over time. The dominant pre-1970s view did not associate the central bank with inflation. That changed after the association of inflation and high rates of money growth in the 1970s (Hetzel 2008, chap. 1). The prevailing view then changed to acceptance of the view that central banks can control inflation. However, the assumption was that to avoid a socially unacceptable high unemployment rate the central bank had to accommodate through high money growth the inflation caused by cost-push shocks. The genesis of inflation lies in excessive growth of real aggregate demand or in inflation shocks with hard-wired (intrinsic) propagation of the resulting inflation into future inflation, unless the central bank offsets it by raising unemployment. The central bank then faces a tradeoff. It can reduce inflation but only by increasing unemployment. More generally, the central bank can reduce the variability of inflation but only by increasing the variability of unemployment.

4. LEARNING FROM EXPERIENCE

Knowledge of what monetary policies the Fed followed in the past and of how they changed over time aids in the choice between the quantity theory and the nonmonetary view as the better description of how central banks control inflation. The reason is that each of these two views possesses different criteria for the success of monetary policies. According to the quantity-theory view, a monetary policy will work well only if it provides a nominal anchor and allows the price system to determine real variables. From the nonmonetary view, a successful monetary policy requires that policymakers choose an appropriate tradeoff between output (unemployment) variability and inflation variability, given the inflation shocks they confront. Also, policymakers need to achieve an optimal policy mix. Specifically, they should choose the optimal mix among monetary, fiscal, and incomes policies given their assessment of the nature of inflation as demand-pull, cost-push, or wage-spiral.[25]

Monetary policies have evolved with changes in the intellectual and political environment and also with the intellectual temper of FOMC chairmen

[24] In terms of the Phillips curve (2), the central bank would need to raise the real interest rate to reduce aggregate real demand, thereby creating a negative output gap ($x_t < 0$). A negative output gap would offset the positive effect of an inflation shock ($\varepsilon_t > 0$) on inflation (π_t).

[25] "Incomes policies" is the general term for government intervention in the price and wage setting of private markets.

(Hetzel 2008, chap. 2). Modern central banking began with the Treasury-Fed Accord of March 1951. In the changed intellectual environment of the post-war period, monetary policymakers replaced their assumed responsibility under the real bills doctrine to prevent what in their judgment constituted unsustainable increases in asset prices (due to speculation in stock and commodity markets) with responsibility for economic stabilization (Hetzel 2008, chaps. 3, 4, and 5). After the Accord, FOMC chairman William McChesney Martin created a monetary policy that adumbrated that of the Volcker-Greenspan era.[26]

Two major events shaped the monetary policy invented by Martin (and his advisor Winfield Riefler). First, with the 1953–1954 recession, the FOMC began to move the funds rate in a measured, persistent way in response to changes in the economy's rate of resource utilization. Second, when price stability ceded to inflation in the period from mid-1956 through 1958 and with the inflation scare of the summer of 1958, Martin began to move short-term interest rates promptly after cyclical turning points. In the spirit of real bills, his purpose was to prevent "speculation" in the financial markets. However, Martin made a momentous change. He directed monetary policy toward preventing the emergence of an inflation premium in bond markets rather than attempting to prevent what in policymakers' eyes constituted an unsustainable increase in asset prices (Hetzel 2008, chap. 5).[27] The Martin FOMC's reaction function, termed here LAW with credibility, foreshadowed that of Volcker-Greenspan (Hetzel 2008, chap. 21).

After the mid-1960s, monetary policy changed with the advent of stop-go.[28] With stop-go, the FOMC attempted to control the growth rate of real aggregate demand in a way that balanced the objectives of full employment and inflation. The appellation, stop-go, came from the practice of pursuing stimulative monetary policy during economic recoveries and restrictive policy later

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[26] See Hetzel and Leach 2001a and 2001b; see also the link, "The Fiftieth Anniversary of the Treasury-Fed Accord" on http://www.richmondfed.org/publications/economic_research. The economics profession understood monetary policy in the context of aggregate-demand management with inflation arising as a consequence of the extent to which the level of aggregate demand stressed resource utilization. Not until the early 1970s did the economics profession assign a significant role to monetary policy as a determinant of aggregate real demand and, thus, as a useful tool for aggregate-demand management. In contrast, Martin understood the control of inflation in terms of the control of credit where the inflationary expectations of financial markets were a gauge of whether the extension of credit was excessive (Hetzel 2005, chap. 5).

[27] During the summer of 1958 and as seen later in 1983 and 1984, the FOMC looked for sharp, discrete increases in the bond rate as a proxy for an increase in expected inflation.

[28] Stop-go began in the Johnson administration. After the passage of the Kennedy tax cut in February 1964, both Congress and the administration united in their opposition to interest rate increases on the grounds that the increases would thwart the expansionary impact of the tax cuts. When inflation rose starting in 1965 and with his own house divided because of the appointment of governors by Democratic presidents Kennedy and Johnson, Martin opted for the use of monetary policy as a bargaining chip. If Congress would pass a tax surcharge, Martin would limit interest rate increases. Fiscal restraint, Martin hoped, would obviate the need for rate increases (Bremner 2004; Hetzel 2008, chap. 7).

on as inflation rose. How did stop-go alter the LAW-with-credibility procedures developed by the Martin FOMC (prior to the populist political pressures that arose during the Johnson administration)? The attempt during business cycle recoveries to lower unemployment (reduce the magnitude of the negative output gap) caused the FOMC to put inertia into short-term interest rates relative to cyclical movements in real output. The FOMC raised interest rates only belatedly after cyclical troughs when the unemployment rate was still high. Similarly, it lowered interest rates only slowly after cyclical peaks. As a result, money growth became pro-cyclical—rising and high during economic recovery and falling and low during recessions. With a lag, inflation followed these changes in money growth (Hetzel, chaps. 23–25). In go phases, the presumption was that a negative output gap (high unemployment) would allow monetary policy to be stimulative without raising inflation. In stop phases, the presumption was that a moderate negative output gap would allow a reduction in inflation at a socially acceptable cost in terms of unemployment—the policy of gradualism (Hetzel 2008, chaps. 7 and 8).

Stop-go arose from a conjunction of a political environment that demanded uninterrupted high real growth and low unemployment with an intellectual environment promising that government aggregate-demand policies could deliver these objectives. The Keynesian consensus held that the optimal combination of fiscal and monetary policy could deliver sustained real growth and high output while incomes policies could limit the resulting inflation (Samuelson and Solow [1960]1966). As manifested in beliefs about monetary policy, that consensus rested on two key premises. First, the price system does not work well to maintain full employment. From 1958 through 1965, excess unemployment (a negative output gap) apparently appeared in the form of an unemployment rate well above the assumed full-employment rate of 4 percent. Second, the price level is a nonmonetary phenomenon with inflation engendered at various times by either excess aggregate demand (demand-pull) or supply shocks (cost-push) and propagated by inflationary expectations untethered by monetary policy (a wage-price spiral).

This hard-wired (intrinsic) propagation of inflation supposedly imparted inertia to inflation relative to changes in aggregate nominal demand. Inertia in actual and expected inflation allows the central bank to exercise discretionary control over real variables (such as unemployment) through its control of aggregate nominal demand (expenditure). However, the downside of this inflation inertia is that the central bank has to create a significant amount of excess unemployment to offset the effects of inflation shocks and to maintain low, stable inflation. Because of this assumption, policymakers generally did not believe that monetary restriction was the socially optimal way of controlling inflation. Given the consensus that the inflation of the 1970s resulted from cost-push shocks propagated by a wage-price spiral, with the exception

of the Ford administration, all the presidential administrations from Kennedy through Carter used some form of incomes policies to control inflation.

Note the importance of the interaction between the above two premises about the inefficacity of the price system and the nonmonetary character of the price level. In a series of articles, Orphanides (for example, Orphanides 2002) documented the widespread belief during the 1970s that the unemployment rate exceeded its full-employment level (or the NAIRU, the non-accelerating inflation rate of unemployment). Using a Taylor rule framework, Orphanides (2003) attributed the inflation of the 1970s to this misestimation of the output gap. But why did policymakers not promptly revise their estimate of full employment with the first appearance of inflation? The reason is that they attributed inflation to cost-push factors. The assumed ability to parse the origin of inflation and decide whether an aggregate-demand policy or an incomes policy constituted the appropriate response was a far more fundamental failure than the technical issue of estimating the NAIRU correctly.

In the stop-go period, policymakers understood monetary policy as requiring the exercise of ongoing discretion about the socially acceptable level of unemployment to allow and, as a consequence, what amount of inflation to tolerate (Burns 1979; Hetzel 1998 and 2008, chap. 8). The presumed necessity of raising the unemployment rate to reduce an inflation rate assumed driven by cost-push shocks and propagated by a wage-price spiral appeared to demand discretion to manage adverse political reaction (Burns 1979). While a hard-wired inertia in inflation and inflationary expectations appeared to allow for this discretionary control of real variables, such inertia made the excess-unemployment cost of controlling inflation appear very high. Discretion, however, meant that nothing in central bank procedures imposed constancy of a nominal variable (such as stable long-run money growth) as a way of disciplining period-by-period funds rate changes to assure the time-consistency of policy (Hetzel 2008, chap. 1).[29]

The experiment with the discretionary juggling of unemployment and inflation targets caused expectations to change in a way that eventually vitiated the ability of the central bank to control real variables such as unemployment. The United States had entered into the period of stop-go policy from an environment of expected price stability created by the long experience with a commodity standard and, after the 1951 Treasury-Fed Accord, a monetary policy focused on price stability (Hetzel 2008, chaps. 4–7). For this reason, initially, the expansionary policy followed in the go phases of stop-go exerted a positive influence on real output. However, over business cycles, the FOMC allowed the inflation rate to drift upward (Hetzel 2008, chaps. 7,

[29] As the 1970s progressed, some regional Reserve Banks (San Francisco, Richmond, Philadelphia, and Minneapolis) joined St. Louis in arguing that the control of inflation required control of money growth.

8, 11, and 23–25). In 1966, when stimulative monetary policy began to raise inflation, the contemporaneous expectation that inflation was stationary (fluctuated around an unchanged base) allowed both inflation to increase without an increase in expected inflation and output to rise above trend. After 1967, this assumption of stationarity began to diminish until in 1979, it disappeared.[30] In 1979, the public began to associate inflation with the Fed rather than with the market power of large corporations and unions and with special factors affecting markets for energy, food, medical services, and so on (Hetzel 2008, chap. 12).[31] By 1979, inflationary expectations had neutralized the ability of monetary policy to stimulate the economy (Hetzel 2008, chaps. 1, 7, 8, 11, 13, 14, and 26).[32] Stop-go created the expectational environment described in Kydland-Prescott (1977) and Barro-Gordon (1983) in which the anticipatory behavior of price setters neutralizes the ability of monetary policy to control real output systematically.

To understand the completeness of the breakdown of the ability of policymakers to exploit Phillips curve tradeoffs, it is useful to recall statements by past policymakers. In perhaps the most famous statement summarizing the failure of aggregate-demand policies to control unemployment, James Callaghan, British Prime Minister, summarized the British experience in 1976 (cited in Nelson 2001, 27 and Wood 2005, 387):

> The cozy world we were told would go on forever, where full employment would be guaranteed by a stroke of the chancellor's pen, cutting taxes, deficit spending . . . is gone. . . .We used to think that you could spend your way out of a recession. . . .I tell you in all candour that that option no longer exists, and in so far as it ever did exist, it worked on each occasion since the war by injecting a bigger dose of inflation into the economy, followed by a higher level of unemployment as the next step.

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[30] When inflation rose in 1966, initially monetary policy turned restrictive. However, unlike 1957 and 1958 when the Fed stayed with restriction until it had eliminated inflation, in 1967 it backed off (see fn. 28 and Hetzel 2008, chap. 7).

[31] The reason this recognition occurred only slowly was that the public faced the same sorts of problems faced by econometricians making inferences with a small number of observations. There were three sustained surges in inflation. The first followed the Vietnam War and inflation had always risen in war time. The second surge, which began in early 1973, could be explained by special factors dependent on supply shortages in oil, food, etc. The fact that trend inflation remained at about 6 percent after the second surge could be explained by an intrinsic inflationary momentum (the wage-price spiral). Only with the third surge that began in 1978 did any significant part of the economics profession or the public become receptive to Friedman's monetarist explanation for inflation that highlighted high rates of money creation.

[32] Lucas (1996, 679) wrote: "The main finding that emerged from the research in the 1970s is that. . . anticipated monetary expansions. . . are not associated with. . . stimulus to employment and production. . . .Unanticipated monetary expansions on the other hand can stimulate production as, symmetrically, unanticipated contractions can induce depression."

Volcker (12/3/80, 4) observed:

> [T]he idea of a sustainable "trade off" between inflation and prosperity . . . broke down as businessmen and individuals learned to anticipate inflation, and to act in this anticipation. . . .The result is that orthodox monetary or fiscal measures designed to stimulate could potentially be thwarted by the self-protective instincts of financial and other markets. Quite specifically, when financial markets jump to anticipate inflationary consequences, and workers and businesses act on the same assumption, there is room for grave doubt that the traditional measures of purely demand stimulus can succeed in their avowed purpose of enhancing real growth.

Greenspan (U.S. Cong. 2/19/93, 55–6) later made the same point:

> The effects of policy on the economy depend critically on how market participants react to actions taken by the Federal Reserve, as well as on expectations of our future actions. . . .[T]he huge losses suffered by bondholders during the 1970s and early 1980s sensitized them to the slightest sign . . . of rising inflation. . . .An overly expansionary monetary policy, or even its anticipation, is embedded fairly soon in higher inflationary expectations and nominal bond yields. Producers incorporate expected cost increases quickly into their own prices, and eventually any increase in output disappears as inflation rises.

The Volcker (12/3/80, 4) quotation above expresses the situation that he inherited upon becoming FOMC chairman in August 1979 (see also Goodfriend and King 2005; Lindsey, Orphanides, and Rasche 2005; and Hetzel 2008, chaps. 1, 13, and 26). Expected inflation had become positively related both to actual inflation and to above-trend real growth. Expected inflation passed through quickly to actual inflation. By 1979, the Fed was left with very little ability to produce a wedge between actual and expected inflation and, as a result, with very little ability to manipulate excess unemployment or an output gap.

Upon becoming FOMC chairman in August 1979, Volcker turned to money targets as a device for achieving credibility. Especially, Volcker hoped, the commitment to maintaining moderate money growth would convince the public that the FOMC would break the prior pattern of allowing inflation to rise during cyclical recoveries. However, the interest sensitivity of the demand for M1 (the monetary aggregate targeted by the FOMC) produced by the 1980 deregulation of deposit interest rates caused M1 velocity to become pro-cyclical (Hetzel and Mehra 1989). As a result, steady M1 growth would exacerbate cyclical fluctuations.

For this reason, in 1983 the FOMC moved to the LAW-with-credibility procedures originally foreshadowed by Martin. Measured by the inferred

behavior of the inflation premium in bond rates, the FOMC attempted to conduct policy in a way that produced low expected inflation consistent with low actual inflation. It also attempted to produce stable expected inflation in place of an expected inflation rate that rose in response to cyclically high real growth or inflation shocks. The effort by the Volcker-Greenspan FOMCs to reestablish the nominal expectational stability lost during the prior stop-go period finally succeeded in 1996. With the sharp increases in the funds rate in 1994 and early 1995, the Fed at last succeeded in allaying the fears of the bond market vigilantes, who had pushed up bond rates in response to above-trend real growth and inflation shocks (Hetzel 2008, chap. 15). Expected inflation ceased being a function of actual inflation and of above-trend real growth. For example, recently neither the recovery from the 2001 recession nor the sustained oil price shock that began in mid-2004 have raised expected inflation significantly above 2 percent as measured by the yield difference between nominal and TIPS (inflation-indexed) Treasury securities.

In the 1970s, a few economists (starting originally with Robert Lucas at Carnegie-Mellon and later at the University of Chicago) argued that the stagflation of the 1970s (the persistence of inflation despite assumed excess unemployment) resulted not from cost-push inflation but rather from the way that monetary policy conditioned inflationary expectations.[33] That is, it resulted from a lack of central bank credibility. Like the monetarists in the 1950s and 1960s, these economists constituted a miniscule minority of the profession. However, the success of the Volcker policy of disinflation changed dramatically the intellectual environment. Under Volcker, as a result of a focus on expected inflation, the FOMC simply accepted responsibility for inflation without regard to its presumed origin as aggregate-demand or cost-push (Hetzel 2008, chaps. 13 and 14). The desire to establish the credibility required to control expected inflation imposed overall consistency on monetary policy (Hetzel 2008, chap. 26). The demonstrated ability of monetary policy not only to control inflation but also to do so without periodic recourse to "high" unemployment gave credence to the idea that the central bank could control inflation through consistent application of policy thought of as a strategy. The application to monetary policy of the ideas of rational expectations by Lucas (1972, 1976, and 1980) and of rules by Kydland and Prescott (1977) went from being an intellectual curiosity to part of mainstream macroeconomics.

5. QUANTITY THEORY VERSUS THE NONMONETARY VIEW

Volcker and Greenspan resurrected Martin's policy of LAW with credibility in the form of "inflation targeting," in which the term does not refer to an

[33] Lucas (1972) developed the idea of rational expectations to undergird the idea that the central bank cannot systematically control real variables.

explicit inflation target but rather to policy procedures that keep trend inflation constant at a low level. Which view—the quantity-theory view or the nonmonetary view—provides the better framework for understanding the success of this policy? That is, how did the Volcker and then the Greenspan FOMCs discipline the "measured, persistent" changes in the funds rate made in response to sustained changes in the degree of resource utilization to maintain trend inflation unchanged in response to aggregate-demand shocks?

The quantity-theory view suggests an interpretation of the Volcker-Greenspan procedures in terms of what I call a "classical dichotomy." Credibility creates an expectational environment in which firms set prices consistent with unchanged trend inflation. Changes in the real funds rate then track the natural rate and allow the price system to determine real variables.

According to the nonmonetary view, the FOMC manipulates excess unemployment (an output gap) to manage inflation and inflation variability according to tradeoffs summarized by a Phillips curve. However, the experience with stop-go was not consistent with the existence of the required exploitable Phillips curve. The problem was that inflationary expectations changed in a way that offset the attempted control of real variables. It follows that if the central bank cannot manipulate the inflation rate to control unemployment then it also cannot manipulate unemployment to control inflation.

Moreover, the nonmonetary view does not accord with the policy procedures of the Volcker-Greenspan FOMCs. According to the nonmonetary view, periodic inflation shocks cause inflation to overshoot the central bank's (implicit) inflation target. There is a fixed sacrifice ratio, which is defined as the excess-unemployment cost of eliminating each percentage point of an inflation overshoot.[34] While the central bank can "stretch" the sacrifice ratio by eliminating inflation overshoots over long intervals of time, it must set a path for excess unemployment to constrain period-by-period funds rate changes such that the total of excess unemployment cumulates to the product of the inflation overshoot and the sacrifice ratio. However, nothing in the Volcker-Greenspan FOMC procedures corresponded to the treatment of excess unemployment as an intermediate target controlled as an intermediate step in controlling inflation (Hetzel 2008, chap. 21). Changes in the unemployment rate were merely an indicator of the change in the degree of resource utilization instead of an independent target.

[34] The number of man-years of unemployment in excess of full employment required to lower the inflation rate one percentage point.

6. CONCLUDING COMMENT

In the Volcker-Greenspan era, the desire of the Fed to reestablish the nominal expectational stability lost in the stop-go period produced rule-like behavior in the form of LAW with credibility. This policy separates the operation of the price system from the control of inflation—a classical dichotomy. Monetary policy relinquished determination of real variables to the price system while providing a stable nominal anchor in the form of low, stable expected inflation.

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